The COUPP Collaboration

THE UNIVERSITY OF CHICAGO

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National Science Foundation
Kavli Institute for Cosmological Physics
Department of Energy

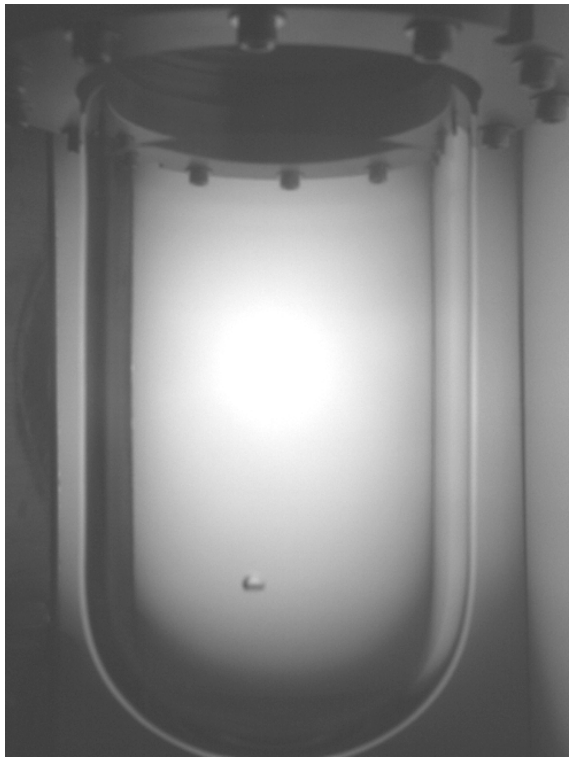
COUPP (E961)

• An experiment to search for dark matter particles with a new bubble chamber technology.

• Initiated with tests of 1-liter (2 kg) chamber in NuMi gallery as Test Beam Proposal T945

• Development of larger experiment (~60 kg target) approved by director in Nov. '06 after consideration by PAC (see **www-coupp.fnal.gov**).

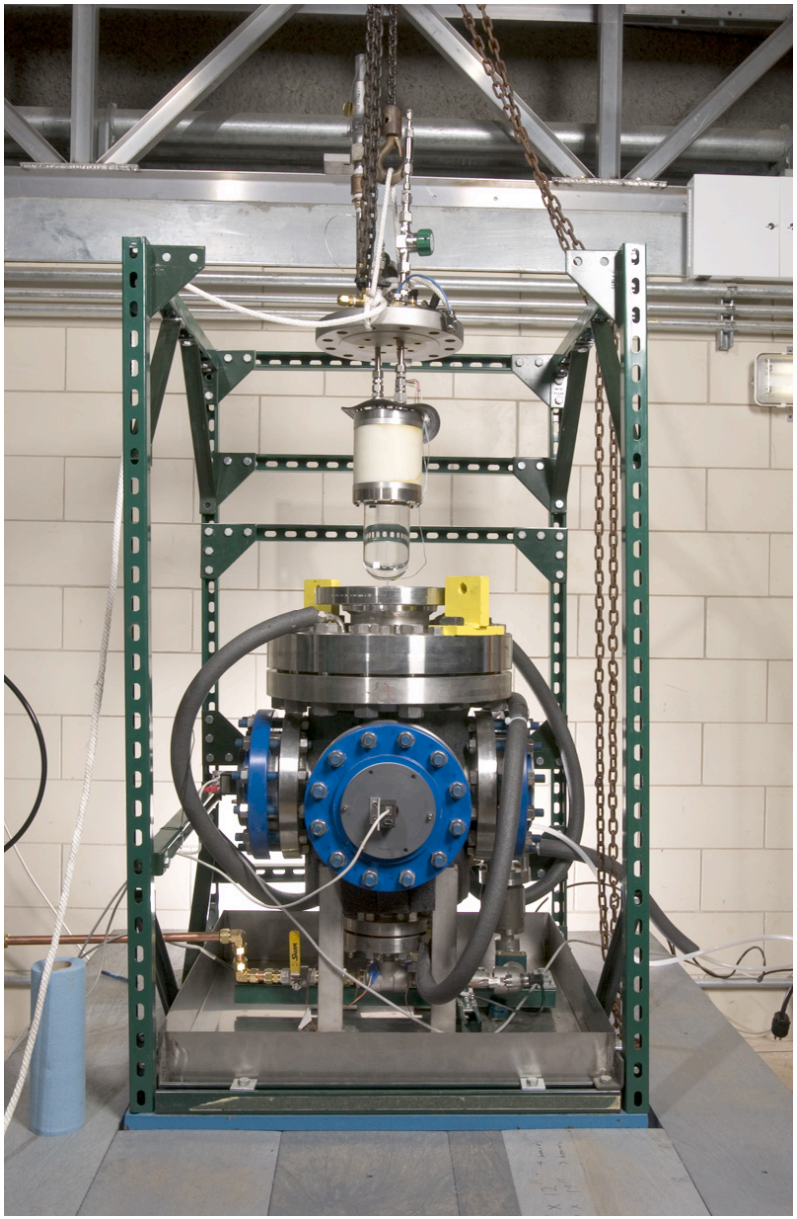
Our signal:
single bubbles

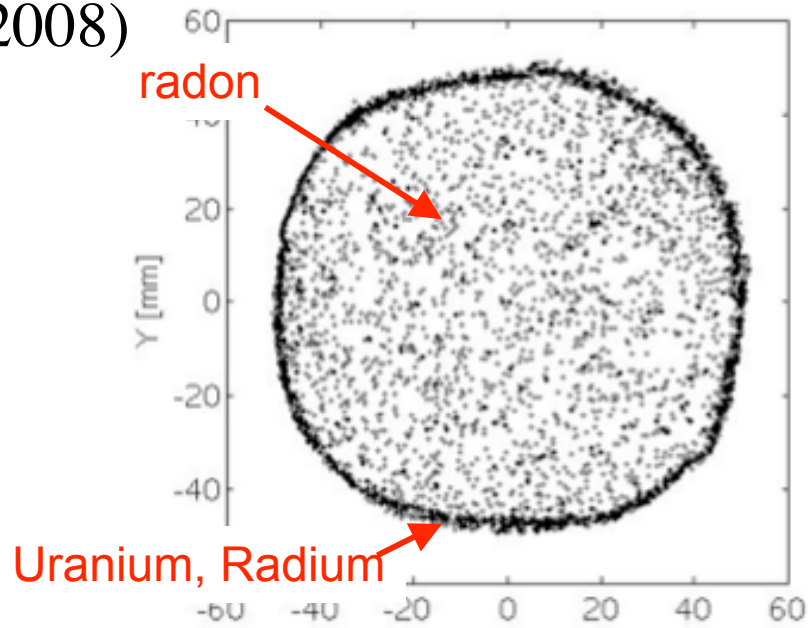


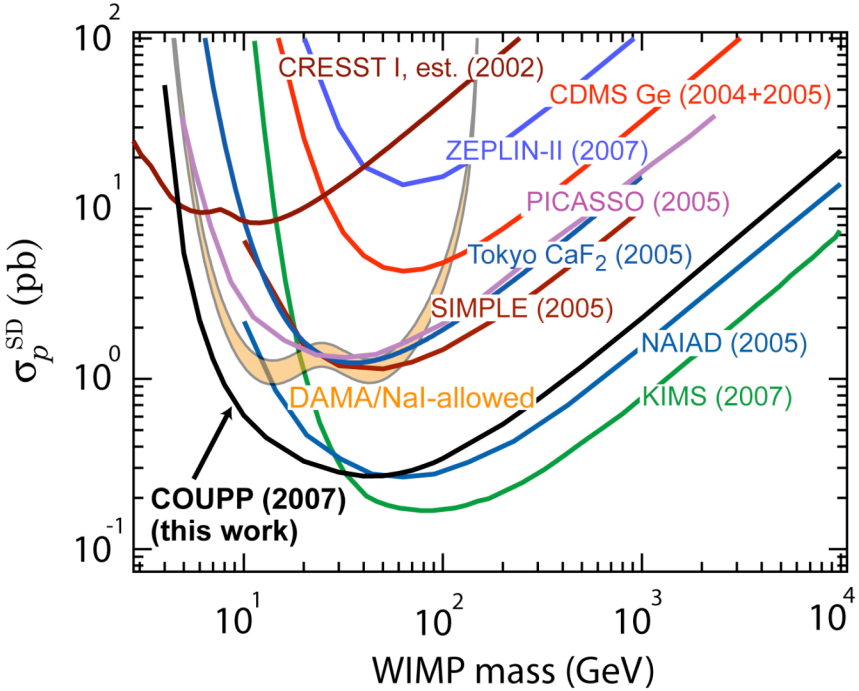
Principle background:
alpha decay from radioactive impurities in detector liquids

(neutrons also important, but less challenging)

2 Kg (1 L) Chamber at NuMI (2005-2008)



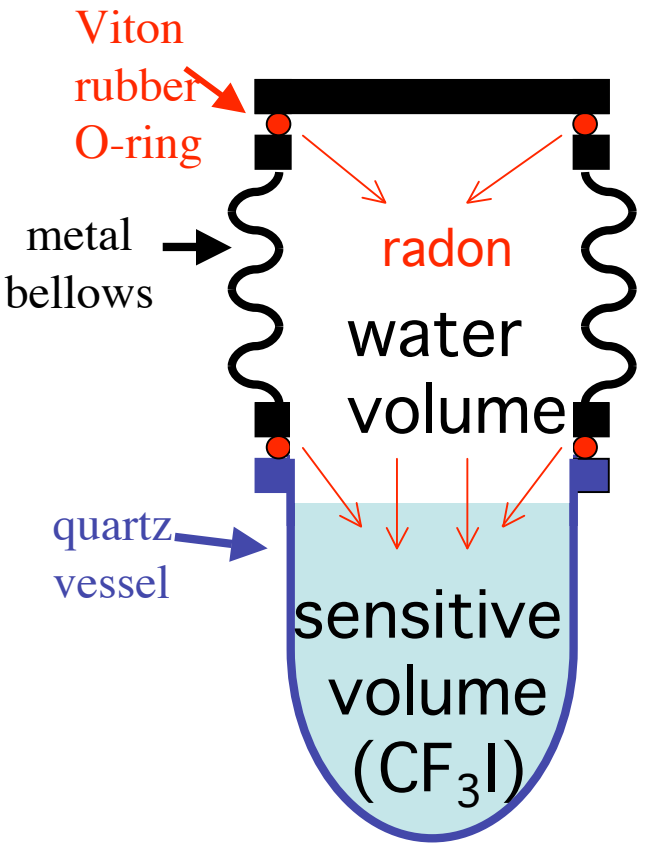




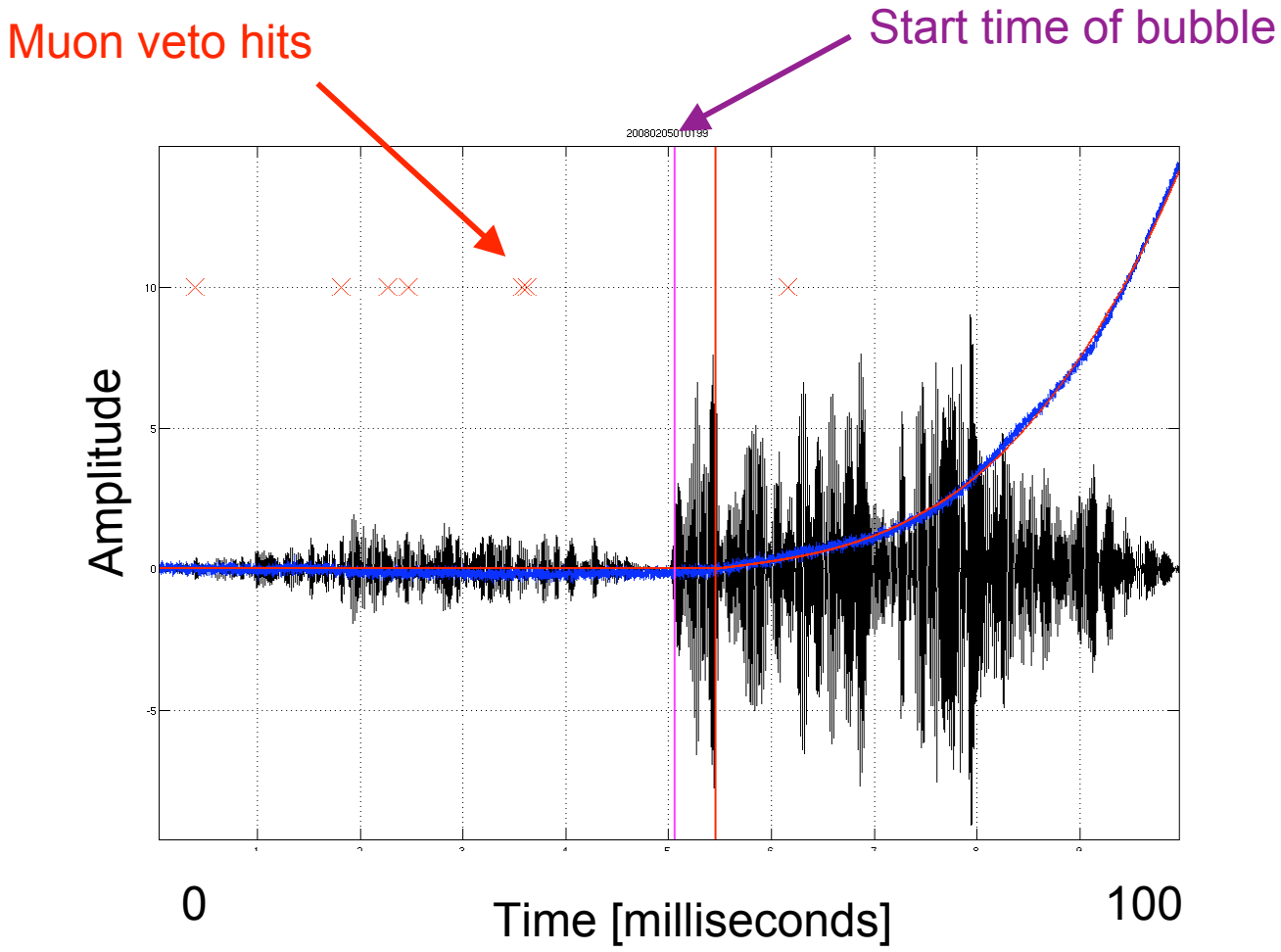
Science, 319: 933–936 (2008).

Most Recent Run (July '07- June '08)

- New quartz Inner Vessel
  - Lower exposure to atmospheric radon, but still low purity quartz
- New bellows assembly with non-thoriated welding
- **Improved quartz-to-metal seals**
  - Viton rubber -> Teflon- coated Inconel
  - Low radon emanation
    <1.6 atoms per day per O-ring
- Improved cleaning procedures
  - Accelerator division clean rooms at A0
- **Ultra high purity water from SNO**
- Improved photography
- Improved operations procedures
- **Muon veto system**
  - Counters surplus from KTeV

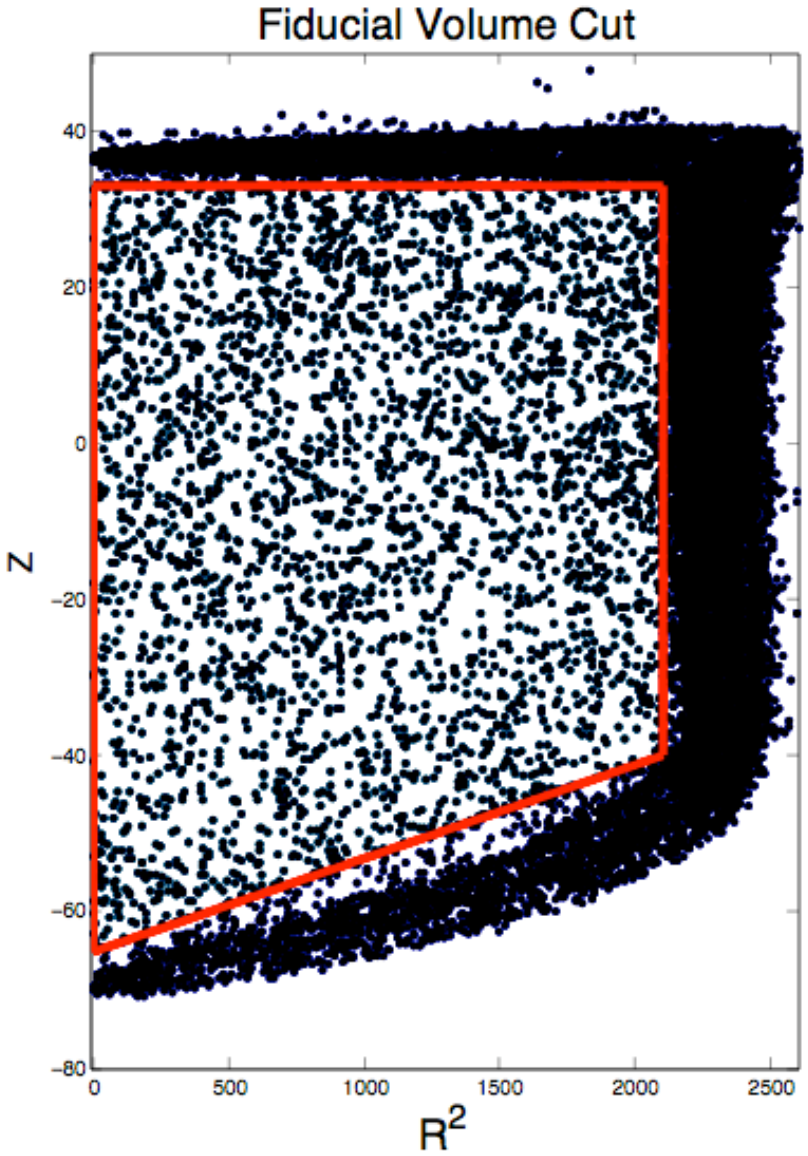


Timing Bubbles With Acoustic Pulses

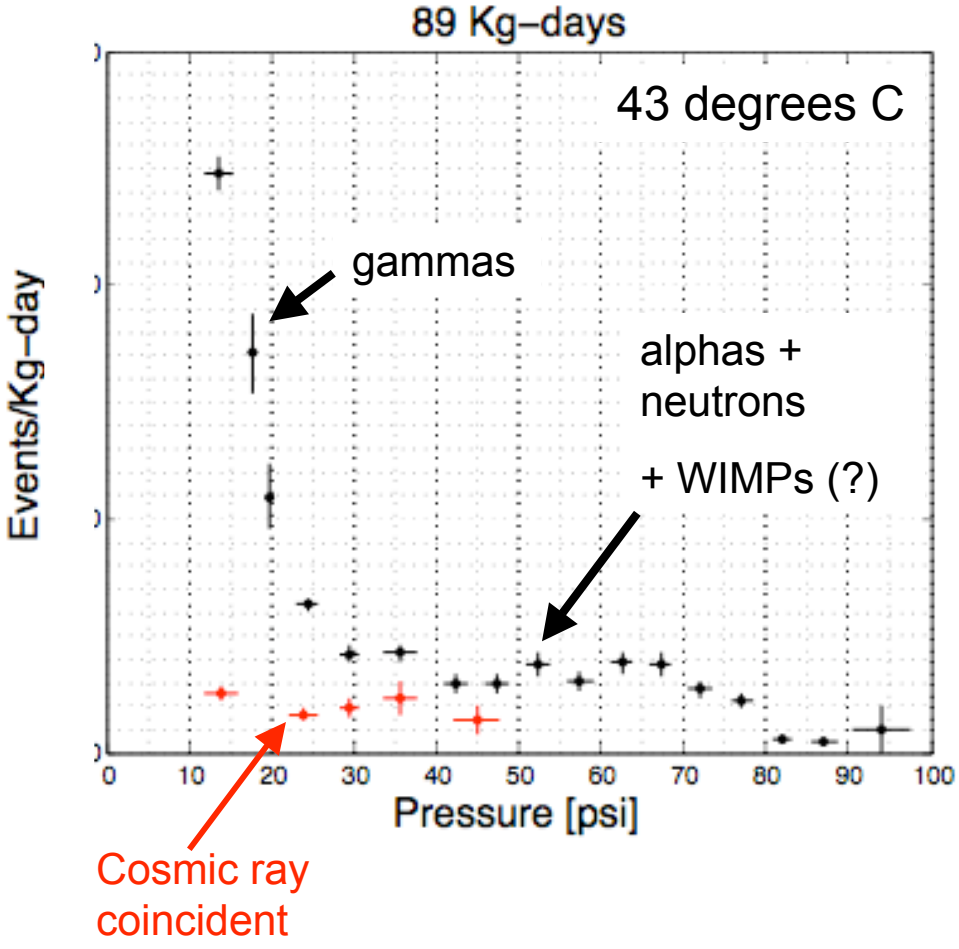


- High efficiency when pulses are relatively large (low operating pressure, low energy threshold)
- Becomes challenging as energy threshold is increased.

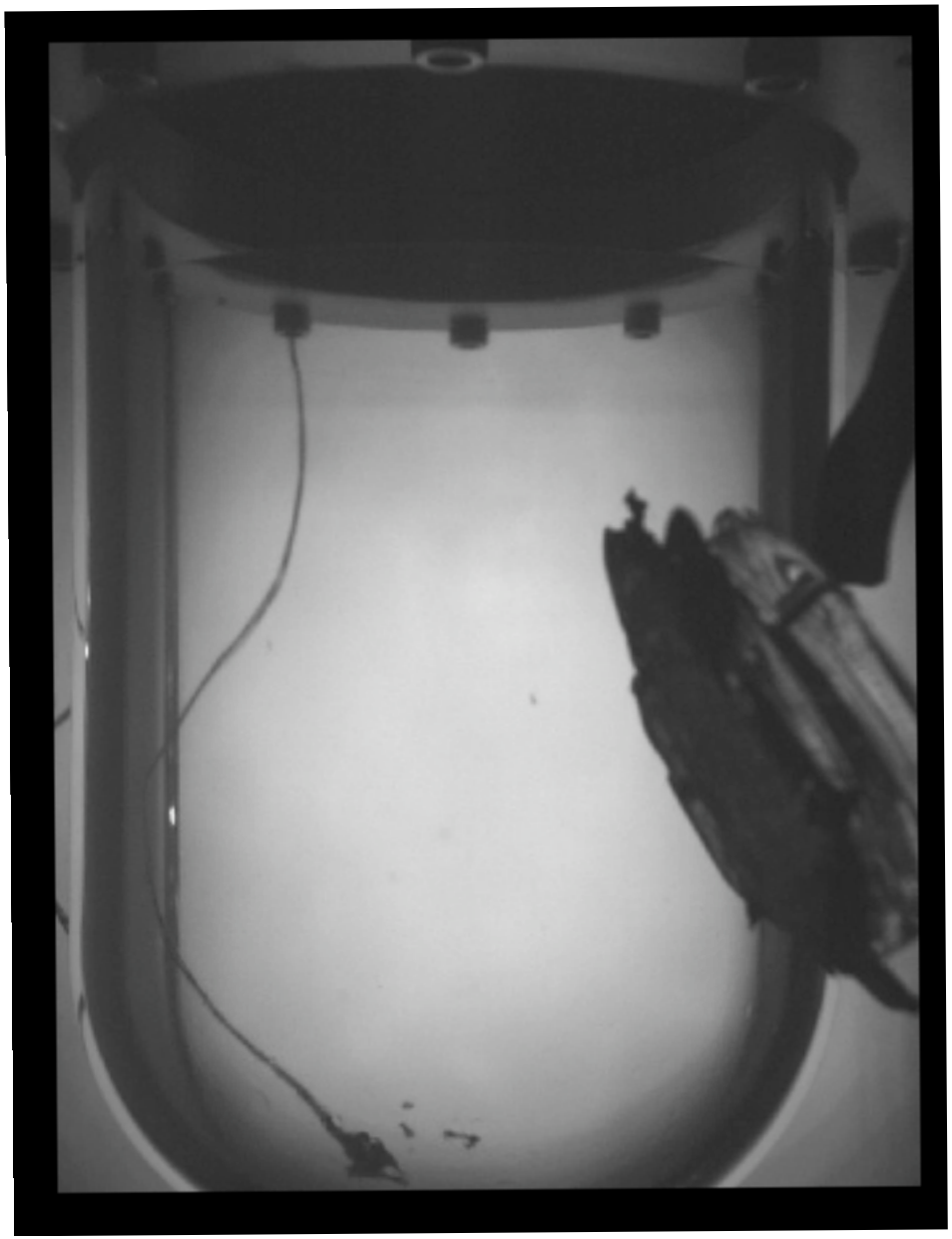
Data From July '07-June '08 Run



- Wall events unaffected
- **Radon greatly reduced !**



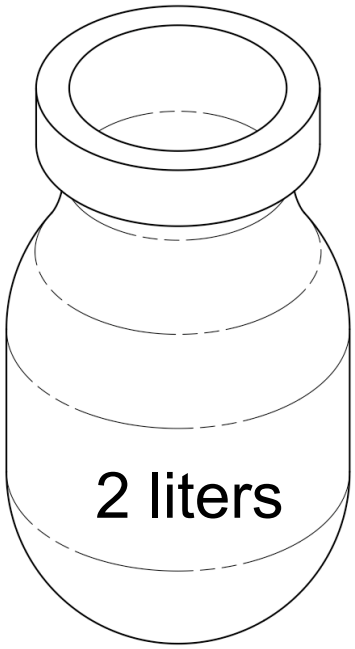
Acoustic Transducer Comes Unglued

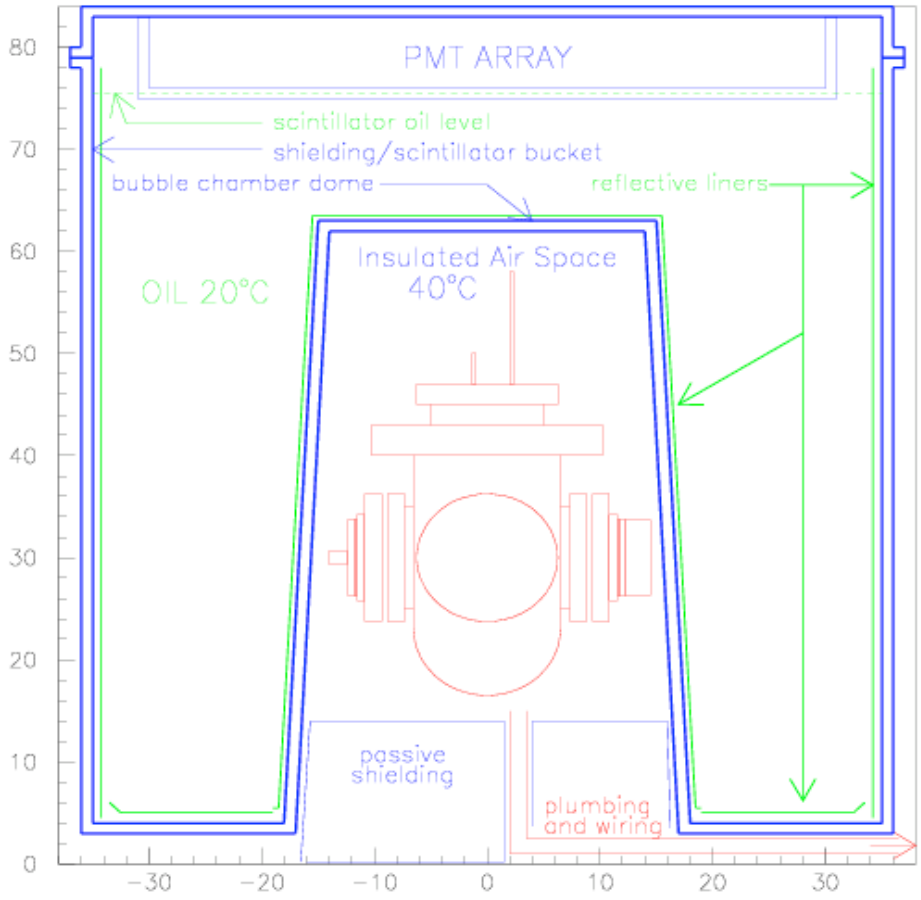


Upgrades for Next Run of Small Chamber (~ Sept.)

- 1 liter natural quartz vessel (42 ppb Uranium)

  –-> 2 liter Suprasil synthetic quartz (21 ppt Uranium)
- Liquid scintillator veto tank for better muon identification.
- Improved pressure controller.





60 Kg Inner and Outer Vessels

- Experiment was approved in Nov. 2006, construction now about 70% finished.
- Expect physics running in 2009 at Soudan Mine (earlier tests at NuMI)

60 Kg Prototype Ready For Testing

COUPP-60 Remaining Work

- Test bubble chamber functionality with prototype inner vessel. Started last week
- Finish video and lighting systems (smart cameras, LED array)
- Low radioactivity water production and filling system.
- Water tank.
- Build final high-purity inner vessel.

  Synthetic quartz arrives from vendor in September.
- High purity cleaning and clean room assembly. October 2008
- Muon veto system.
- CF_3I handling module.
- Install in NuMI tunnel December 2008
- NuMI run to check that backgrounds are under control, first physics.
- Installation in Soudan Mine Summer 2009?
- Soudan physics run.
- Radiopurity upgrades

  We want at least a 2 order of magnitude reduction in alpha backgrounds